

DUANE (A)

THE MODERN TREATMENT

— OF —

STRABISMUS.

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[FORMERLY OF NORFOLK, VA.]

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—THE—

MODERN TREATMENT OF STRABISMUS.

By ALEX. DUANE, M. D., of New York, N. Y.

(Recently of Norfolk, Va.)

The correction of squint has been heretofore regarded as the simplest of surgical procedures. Done, as it usually is, for the cosmetic effect only, no special care is taken either to measure precisely the degree of the abnormality or to gauge the amount of correction obtained by the operation. All of us have seen the ordinary squint operation; and we all know what a slashing performance it is. A few rough tests are perfunctorily made, not so much to determine the degree of deviation (for which, indeed, they would be quite inadequate) as to establish the mere fact of strabismus, and to find out which is the squinting eye; then the anæsthetic is given; an incision is quickly made in the conjunctiva; the tendon divided through and through with a snip or two of the scissors; the hook pushed in, raked up and down, and every bit of tissue caught up and divided; a momentary glance is taken at the relative position of the eyes; then the surgeon announces that "the eyes seem to be pretty straight now," and, having put in a conjunctival stitch and applied a bandage, walks off with the sense of having done a successful and brilliant operation. Possibly he may find, in the course of the after-treatment, that he has overdone his work; he will then do an advancement. More likely he will find that he has not done enough; then he will operate on the other eye. But in no case will he, before the operation or subsequently, determine the exact amount of the angle by which the faulty eye deviates, nor will he, by the aid of tests made *during* the performance of his operation, attempt to

limit the latter and adjust it so as to correspond accurately with the amount of trouble found.

That this is no fancy picture, all can testify. I myself distinctly remember a strabismus operation of this sort that I saw four or five years ago. It was done at the oldest ophthalmological institution in New York city, and the operator was a man of deservedly national reputation. The patient had been prepared, and everything was in readiness; but the surgeon had not come. Suddenly the door flew open, and with the air of one who has no time to lose, the operator rushed in. He did not even lay aside his overcoat, but, seizing forceps and scissors, had, in a flash, snipped open the conjunctiva, slashed the tendon with one or two jerky cuts, swept the hook, first up, then down, through the whole area of the wound—had thrown down his instruments, snatched up his hat, and gone; having occupied about as much time in doing the operation as I have taken in describing it. The whole performance was brilliant, dashing—a fine example of surgical sleight of hand; but was it scientific, was it good surgery?

Contrast with this sort of operation that detailed in the latest publication on the subject of strabismus by one who, whatever may be thought of his theories in regard to muscular anomalies of the eyes, is, without question, a master of the technique of ocular operations. Dr. G. T. Stevens, in a recent number of the *Archives of Ophthalmology*, after a careful study of the whole subject, in which he shows that the determination of the degree, and even of the direction of deviation, is often a matter of extreme difficulty, requiring repeated tests and great patience, says: "In no case should a full correction be attempted until the relations of the visual lines have been carefully observed." And again: "The correction of squint, with the view of obtaining perfect binocular vision throughout the whole range of vision, instead of being one of the easiest of surgical operations, is a procedure demanding the supreme ability of the accomplished observer, and the highest skill of the dexterous operator." These statements, coming from one who has himself done many thousand tenotomies, and to whose diagnostic ability and consummate operative skill I can myself, from oft-repeated observation, bear witness, should command earnest attention. They accord so closely with

my own experience that, for my own part, I have no hesitation in giving my full assent to them.

Granting, then, that every case of squint should be carefully and repeatedly examined until we are perfectly satisfied as to the conditions existing, we must now inquire what treatment is applicable. Self-evidently, the treatment must vary according to the kind of squint present, and the cause underlying it. It becomes us, therefore, before deciding how strabismus shall be corrected, to ascertain how it can be caused.

Broadly speaking, there are, as Mauthner has pointed out, four varieties of strabismus. These are—

1. *Spastic squint*, or the variety in which the eye deviates because one of its muscles is spasmodically contracted. This variety, according to Mauthner, scarcely exists except as the result of central irritation (as from epilepsy, hysteria, meningitis,) and its treatment, therefore, is that of the general disease which underlies it.

2. *Accommodative squint*, or the variety dependent upon extreme accommodative effort in hypermetropes. This is evidently to be treated by atropinization, continued, if necessary, for many days, so as to completely paralyze the accommodative effort, and subsequently, by fitting the patient with appropriate glasses. In the same category may be ranked the strabismus ex anopsia, in which the deviation cannot be permanently removed, unless the faulty vision of the deviating eye is, in some way, improved.

3. *Concomitant squint*, or the variety in which, although the ocular muscles are equally endowed with nervous and inherent energy, the eye still deviates, because one of the muscles is too short or its antagonist too long.

4. *Paralytic squint*, in which one of the ocular muscles is paralyzed.

It is in the last two varieties only that there can be a question of operative interference; and it is mainly in regard to this question that the present paper has to do.

In concomitant squint, where the deviating eye is simply held in a wrong position by the tension of one of its muscles, the indication, at first sight, seems obvious. Cut the restricting tendon, and the eye will right itself. But the case is not as simple as this brief statement would seem to make it. By the very act of divid-

ing the tightened tendon, we relax its opponent, and perhaps seriously impair its efficiency. Moved by this, and by other considerations, Landolt, in his paper before the last Ophthalmological Congress, strongly urged advancement of the antagonist as a regular substitute for tenotomy in concomitant strabismus. His views receive re-enforcement from the fact that an advancement, as performed now-a-days, is a much more certain, much more controllable operation than it used to be. Indeed, when done with the refinements of modern technique, and when controlled by careful tests, it is about the most precise operation in surgery. That this is so, is largely due to Dr. G. T. Stevens, of New York, who has done so much to insure precision in the tests, and delicacy in the operative procedures; and if now we shall avail ourselves, much more largely than formerly, of advancement in the correction of strabismus, we must acknowledge that we shall be enabled to do so mainly because of the laborious experiments and original investigations of this ophthalmologist.

The whole question, however, of the choice between tenotomy and advancement in concomitant squint appears to me to depend upon conditions which often receive too little attention. I mean the conditions of tendon-tension and tendon-relaxation—terms, the bearing of which I can best show forth by the following practical illustrations:

CASE I.—A patient comes into our office with a divergent squint (exotropia) of 8° ; adduction of the affected eye is very imperfectly performed; abduction (in excess of the amount of exotropia) is of moderate power (from 4° to 8°). In eyes-front, there is crossed diplopia, soon passing in eyes-right to single vision, while in eyes-left the crossed diplopia rapidly increases.

Here we have evidently a deviation of direction merely, the right eye being, so to speak, *set* outwards, while its power of *moving* outwards is not very great, and its power of moving in is very small. Here tenotomy of the right external rectus, followed by assiduous training of the adduction by prismatic exercise to strengthen the interni would probably effect a complete cure. It might even be necessary, in such a case, to follow a rather extensive, but still graduated, tenotomy of the external rectus, by a moderate tenotomy of the internal rectus; a procedure apparently irrational, but really quite justifiable, and indeed demanded, if the two opposing recti are both too much upon the stretch;

for each muscle would then be hampered by its own excessive tension, and would be rendered more capable of action by being released. The proposition that a muscle may be actually strengthened by the division of its tendon may seem a little paradoxical; but, when we reflect that the chief effect of such a division is to alter the point of insertion of the tendon, and that this alteration may give a more advantageous point of application than before, we can readily see how this can be. That it actually is so, seems to be proved by the fact that many cases of esophoria (so-called insufficiency of the *externi*) are associated with marked impairment of the power of the internal recti, and that the latter, after division of their tendons, are capable of much greater effort than before.*

Contrast Case I, in which the eye is, as it were, "strung up" by the excessive tension of one or both of its tendons, with the following case, whose history, abridged from my note-books, is here presented :

CASE II.—Miss M., aged 18, had an attack of diphtheria some eight or nine years ago, followed by a paretic affection of the ocular muscles. Since then it has been noticed by many that her eyes roll out during any attempt at fixation. She has headaches almost every day. Examination (June, 1889,) shows both eyes deviating out markedly behind the screen. In attempting to fix one eye, the other eye always wanders out several mm. This tendency to wander off is most marked with the left eye, and this is true both for distant and near vision. Tests with the prism and the red glass show *homonymous diplopia* and an *esotropia* of 12° or more. In other words, the eyes, when at rest or in a state of fixation, swing apart from each other in a perfectly perceptible way, while, if her attention is directed to their relative position, they swing towards each other so far that objects appear to her as they do to one affected with convergent squint. That, however, the eyes actually do diverge from each other, is shown by the fact that along with the homonymous diplopia the patient usually exhibits a crossed parallax. Tests of the dynamic capacity of the eye show that abduction and adduction, at first very limited, increase rapidly by exercise, so that soon the patient can swing her eyes in or out at will through a very wide arc, although she still always has homonymous diplopia, and her diverging power,† therefore, is negative.

* Dr. Stevens was, as far as I know, the first to call attention to this fact.

† As distinguished from exokinesis. For the distinction between these terms, see article by the author in the *New York Medical Journal*, August 3, 1889.

So contradictory were the results outlined in the above abstract, that they would have been regarded as errors of observation had they rested upon a single observation. But, in order to obtain certainty in a matter of such difficulty, the examinations were repeated until twenty separate tests on as many different days had been made, the result being essentially the same in all. Then contrary to all indication derived from the appearances of the eyes, and acting solely upon the indications furnished by the prismatic tests, I advanced the right *external* rectus, and some days afterwards, increased the effect of this operation by tenotomizing the right internal rectus. The result of this apparently unjustifiable operation, was that the esotropia was, by a procedure which seemed calculated only to increase it, reduced from 12° or more, to but 2° ; the diverging power, instead of being negative, became $+4^{\circ}$; the homonymous diplopia, while still present when the red glass was used, was no longer insuperable, and—a result entirely unexpected—the headaches, formerly of daily occurrence, disappeared so completely, that from the date of the operation (July 9, 1889), to the present time (September, 1, 1890), or fourteen months, she has had but five in all.

On July 23, 1889, a similar operation was performed upon the left eye, tenotomy of the internal rectus being combined with advancement of the external rectus. Here, however, owing apparently to the singular anatomical disposition of the tendons, which were very long, loose and narrow, and but scantily attached to the sclera, too free a tenotomy was made, and the patient, on the second day after the operation, suddenly developed crossed diplopia, exotropia of 10° to 15° , and marked loss of converging power. This over-correction was finally remedied by persistent exercise of the adduction, and by a series of graduated advancements of both *interni*, and the final result at the date of writing is as follows:

Exophoria, 6° or 7° ; diverging power, 15° , sometimes more; converging power, 72° ; single vision at all distances from three inches to infinity, and in all parts of the field of view except occasionally in eyes-left when she may have crossed diplopia, which, however, is so readily overcome, as to be momentary only; left eye steady under all conditions of fixation. The right eye wanders out a little occasionally, and she can, by voluntary effort, roll it out about $1\frac{1}{2}$ mm., and by so doing can produce a crossed diplopia of 15° , but this effort is difficult for her to make, and cannot be long maintained. In point of general health and of freedom from headaches, she is very greatly improved.

The distinction between Cases I and II, are obvious. In the former, the eyes deviated out because they were held out; in the latter, they deviated out, because they were allowed to swing out. In the one case, the tendons were too much upon the stretch; hence, tenotomy to relax the tense cords was indicated; in the other, the tendons were too lax, and allowed too great a swing, hence advancement* was demanded.

If we turn now to the treatment of *paralytic strabismus*, we are at once confronted with perplexing problems. In many cases we shall find all treatment unsatisfactory. Many cases, it is true, get well; but their cure is spontaneous, not due to treatment. Nor is the patient always to be congratulated on his recovery, for, as Mauthner tells us, it is just these cases with rapid recovery, in which a bad prognosis is indicated; for such cases are fore-runners of diseases of the central nervous system, and particularly of locomotor ataxia. Diphtheritic paralyses, of course, tend to get well; but these are extremely rare. I count myself fortunate that I have seen two cases, inasmuch as Alfred v. Græfe, with all his vast experience, has scarcely seen more. Syphilitic paralyses, do not, as a rule, yield to internal treatment; and as they are late manifestations of the disease, the outlook is bad. The so-called rheumatic paralyses may recover under treatment (or without it); but the diagnosis of all such cases is generally very doubtful. Local treatment, as by electricity, forced traction of the eye-balls, and orthopædic exercises, is, according to Mauthner, of little utility, although I think that I have seen good results from the last-named method.

The question of operative interference usually presents itself after other means have been exhausted. This is indeed very proper, and in any case, we should not undertake an operation until assured that the paralytic condition is stationary; otherwise, we might, in our endeavors to correct the trouble, make matters just so much the worse. Moreover, it is not all, nor, indeed, more than a small fraction of the cases, in which operative treatment is applicable at all. When applicable, it is often still a puzzling matter to determine just what operation to perform.

The varieties of possible operations are three: First, and most

* And in another such case, would be performed without an auxiliary tenotomy.

ordinarily practised, is the advancement of paralyzed muscle itself—the “substitution operation” of Alfred v. Græfe. Next, is the tenotomy of the muscle, directly antagonistic; that is of the muscle which in the same eye balances in the normal state the effect of the paretic muscle. This is called by Alfred v. Græfe the “equilibrating operation.” In regard to it, it may be remarked that, with the exception of the external and internal recti, which do balance each other’s action, no single ocular muscle has a direct antagonist. The superior rectus, for example, which moves the eye up and in, is in part balanced by the superior oblique which moves the eye down and out; but both act to rotate the vertical meridian inwards; and hence, when by paralysis of one of these muscles, the vertical meridian is abnormally rotated outwards, section of the other muscle would only increase the deflection. So, too, in regard to the inferior rectus and the inferior oblique, which also antagonize each other in respect to two of their functions, and harmonize in the performance of a third, section of one, while remedying a part of the defect due to paralysis of the other muscle, would render the remainder of the defect still more aggravated. Hence, except to the internal and external rectus, the equilibrating operation is scarcely applicable. The third operation practicable, is tenotomy of the associated antagonist. By associated antagonists we mean two muscles, one in each eye, which so act upon their respective organs, as always to turn them in parallel directions. Thus the associated antagonist of the left superior rectus, which turns the left eye up and in (to the right), and rotates its vertical meridian inward (to the right), is the right inferior oblique, which turns the right eye up and to the right, and rotates its vertical meridian to the right. So the superior oblique of one eye, and the inferior rectus of the other, the external rectus of one eye and the internal rectus of the other, are associated antagonists.

Now, it is theoretically demonstrable that tenotomy of the associated antagonist (“compensating operation” of v. Græfe), is by far the most serviceable procedure in paralytic conditions. And, as matter of clinical experience, v. Græfe, who is much the greatest authority upon this subject, has shown that in paralysis of the external and internal rectus, and of the two obliques, the operation gives very satisfactory results. In paresis of moderate de-

gree of the lateral recti, this operation alone may be sufficient. In more extensive deviations, he applies, in addition, the equilibrating operation; and, if this is not sufficient, does also advancement of the paretic muscle. In paralysis of the superior oblique, he has done the compensating operation (tenotomy of the inferior rectus of the other eye), some twenty times. This seems a large number, and yet it is not unlikely that, when more attention is paid to the subject, paralysis, and especially light degrees of paresis of the superior oblique, will be found to be quite frequent. Thus, while Mooren collected only thirty cases among 108,000 cases of eye diseases of all kinds, Alfred v. Græfe saw fifty-two among 40,000 cases. I, myself, in 350 consecutive cases of eye disease, which have been examined with unusual care for muscular anomalies, have seen two cases, upon one of which I operated successfully, according to v. Græfe's method. I have not been so fortunate in observing cases of paralysis of the inferior oblique, which, indeed, are very rare. Alfred v. Græfe, with all his vast experience, has had the opportunity of operating upon only one. Should I see one, however, I would not hesitate to perform the compensating operation, *i. e.*, tenotomy of the superior rectus of the other eye.

The compensating operation is not applicable to paralysis of the superior and inferior recti. This is partly on account of the difficulty of reaching the oblique muscles for purposes of tenotomy—a difficulty, to be sure, not insuperable, since Landolt has succeeded in operating on the inferior oblique, and it is possible to detach the superior oblique from its insertion at its pulley. But apart from the formidable nature of these operations, their performance is likely to be of little service, since the elevating and depressing action of the obliques upon the eye is very much less than that of the recti; and hence, cases of slight paresis only of the latter could be compensated for by even complete section of the obliques. Accordingly, the elder v. Græfe recommended as a substitute a fourth operation—tenotomy of the homonymous muscle of the other eye—*i. e.*, in paralysis of the left superior rectus, tenotomy of the right superior rectus. Alfred v. Græfe, however, prefers, and, as it would seem very rightly, advancement of the paretic muscle itself. The utility of this procedure, I have seen in two cases; one in which there was a natu-

rally paretic condition of the superior rectus, operated upon by Dr. A. C. Palmer, of Norfolk; the other, one of traumatic paresis of the inferior rectus, upon which I operated myself.

To recapitulate in brief, and bring together the points scattered through this perhaps too lengthy essay—

First. Before assuming to treat any case of squint, we must examine carefully into its possible causes, and if it is due to general disease—as hysteria or meningitis in spastic strabismus, or syphilis and rheumatism, in some cases of paralytic strabismus—or if it is caused by undue accommodative effort, as in the periodic squint of hypermetropes—we must try and remove the cause.

Second. Before considering the question of any operation for squint, we must determine the kind (whether concomitant or paralytic), the muscle affected, and whether that muscle is in a state of tension or relaxation. This requires the most careful and assiduous testing, both of the static and dynamic conditions of the eyes. The examinations should be made with the test-object preferably at twenty feet, and should include not only the ordinary prismatic tests, but also the parallax test, and those made with the excursion-movements of the head. To both of these latter tests, a constantly increasing experience leads me to attach a higher and higher value.

Third. In concomitant squint with relaxed tendons, perform advancement, recollecting that it may be necessary to advance even the tendon that is apparently contracted. In concomitant squint with tense tendons, perform tenotomy, regulating the extent of the operation, if necessary, by a subsequent graduated advancement.

Fourth. In paresis of a lateral rectus, tenotomize the opposed muscle of the other eye, re-inforcing the operation, if necessary, by tenotomy of the opposed muscle of the same eye, and if still further correction is needed, by advancement of the paretic muscle. In paresis of the superior oblique, tenotomize the inferior rectus of the other eye; in paresis of the inferior oblique, the superior rectus of the other eye. In paresis of the superior or inferior rectus, advance the paretic muscle.

Fifth. In all cases of tenotomy or advancement, the effect should be controlled by tests made repeatedly in the course of the operation, the latter being carried on till the tests with prisms and parallax indicate a satisfactory balancing of the muscles; and, after the operation, for several days the same tests should be repeated, and the extent of the operation increased or reduced, according to the indications which these tests afford.

